

## **An Introduction of Smart Information & Traffic Management System (SITMS)**

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### **ABSTRACT**

SITMS (Smart Information & Traffic Management System) is a smart highway operation system and is designed as ubiquitous system in which all entities on the road can exchange the information continuously. In other words, it makes the communication between the operator and the user and between the users possible anywhere anytime, and it is an intelligent system to practice the traffic control strategy of preventing road congestion and hazards. This study introduces the development direction and target of SITMS as well as its major services distinguished from existing highway management systems.

### **1. INTRODUCTION**

The drivers will share road information with road managers or among themselves in the future. This is the concept of ubiquitous information environment for road users. Moreover, this information environment will be the driving force for the actualization of optimum traffic control strategy.

SITMS (Smart Information & Traffic Management System) refers to the ubiquitous traffic information management system, which allows free road information exchange through the linkage of advanced vehicle and road system. The development of this system is being carried out by the intelligent road development project for the next-generation smart highways. This study aims at proposing the objective and operation strategy of SITMS and the service contents offered to the users and operators of the system.

## **2. OBJECTIVES OF SITMS**

SITMS aims at building world top-class information highways. It will have the best traffic management capability through continuous and dynamic information environment for all entities on the road. The detailed objectives of SITMS are presented by its essential values as follows.

- Strengthening mobility
  - The system will ensure the driving speed will not fall below 100km/h by controlling the traffic demand to make sure of on-time arrival.
- Strengthening convenience
  - The users of the road will be provided with continuous information communication system so that customized information can be provided to the user on real-time basis.
  - The operators are provided with automatic recognition and countermeasure system for the traffic situation to enhance the efficiency of the Expressway operation.
- Strengthening safety
  - Safety control techniques are used to prevent accidents through the combination of advanced vehicle technology and road sensors.
  - The management system will be capable of recognizing a sudden situation within one minute, making an accurate assessment of the situation within three minutes, and then responding to the unexpected situation within six minutes. (123 strategy)

## **3. SITMS INFORMATION ENVIRONMENT**

Smart information environment is structured so that any information sharing between the road users and road operators (managers) is made possible in any time and space. The information flow between the people on the road and in the vehicle can be shared in conversation manner under this information environment, and the traffic operation system enables advanced traffic control through this information

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exchange. This smart information communication environment is comprised of six connection system between elements of the system and is designed so that every element can be connected among them through this communication system anytime and anywhere. Figure 1 illustrates the concept of ubiquitous and extended road information system for entities on the road.

- V2V : It is the communication system between vehicles for the mutual information exchange made possible through OBU in the vehicle, the direct link between OBU or road Side Equipment(RSE).
- V2I : The users and operators can exchange the mutual information anytime and anywhere on the road through road Side Equipment(RSE) and OBU in the vehicle.
- I2I : The communication infrastructures on the road are improved of its efficiency and economy through the combination of wired and wireless communication technologies.
- I2O : Continuous information will be provided for the users through the connection with other roads of different traffic volume grade and other communication means.
- V2D : The communication environment for giving and receiving information necessary for the safety and communication improvement between the intelligent vehicle and the driver is made possible.
- D2D : A service of new dimension is provided for conversation at will is provided between the drivers on the road through the use of continuous road communication infrastructure.

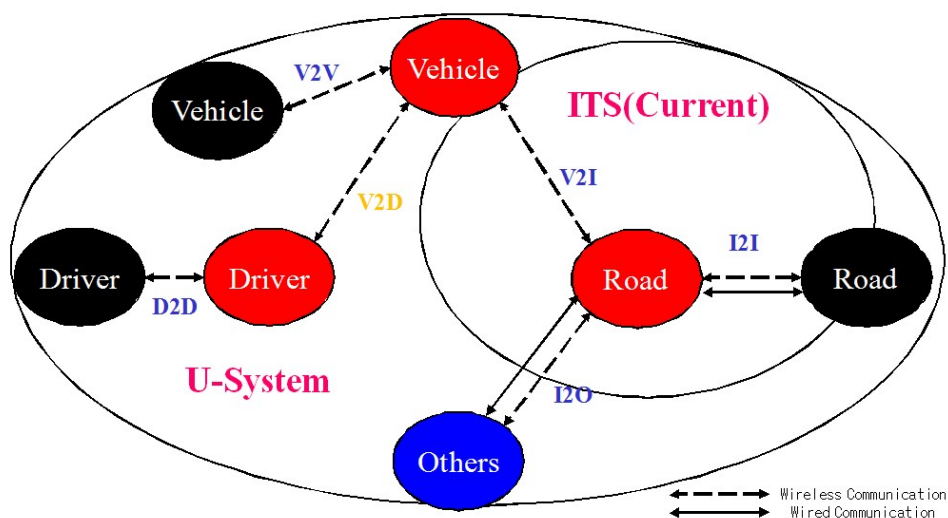


Figure 1. Drawing of the connection system between the entities of the smart road information system

The characteristics of SITMS are as follows.

Firstly, a seamless communication system to make the communication system between entities in all road sectors possible even for the high speed environment of over 100km/h (maximum of 200km/h) is built.

Secondly, the real-time information exchange between the road and vehicle is made possible, and the communication system centering on the OBU in the vehicle for linking the users and operators is built.

Thirdly, the link between the RSE in the road shoulder and OBU in the vehicle has the function of not only providing the information but also collecting the information.

Fourthly, the system is built so that its building and operating cost is minimized in the process of generating and providing the information. If necessary, the fee for using the communication system may not be levied to the users.

Fifthly, the system is built to be compatible with other systems or the needs of other organizations. .

Sixthly, it is designed to be decentralized system to disperse the tremendous communication information for processing.

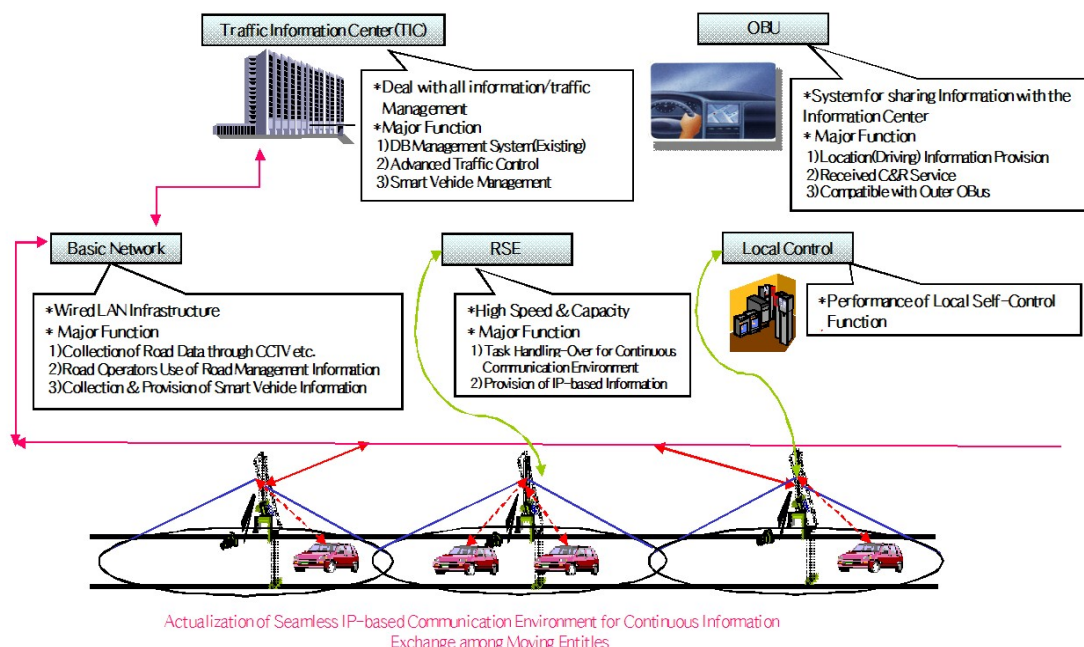


Figure 2. Major functions of the detailed SITMS

#### 4. SITMS CONTROL STRATEGY

#### 4.1. FUNDAMENTAL CONCEPT

SITMS is very advantageous in achieving advanced traffic control techniques, which can secure and improve the road safety and smooth traffic operation, under the smart information environment of direct link to the users. It uses such traffic management techniques as lamp metering control strategy and advanced control techniques during a sudden traffic event.

First of all, the traffic control strategy of smart highway is discussed. The smart highway aims at providing the driving speed of over 100km/h under any circumstances based on its improved intelligent operation system as illustrated in <Figure 3>. In other words, it is a traffic service with a guarantee. Thus, SITMS is designed with the concept of real-time, automation, and direct linkage so that this control function can be fully functional.

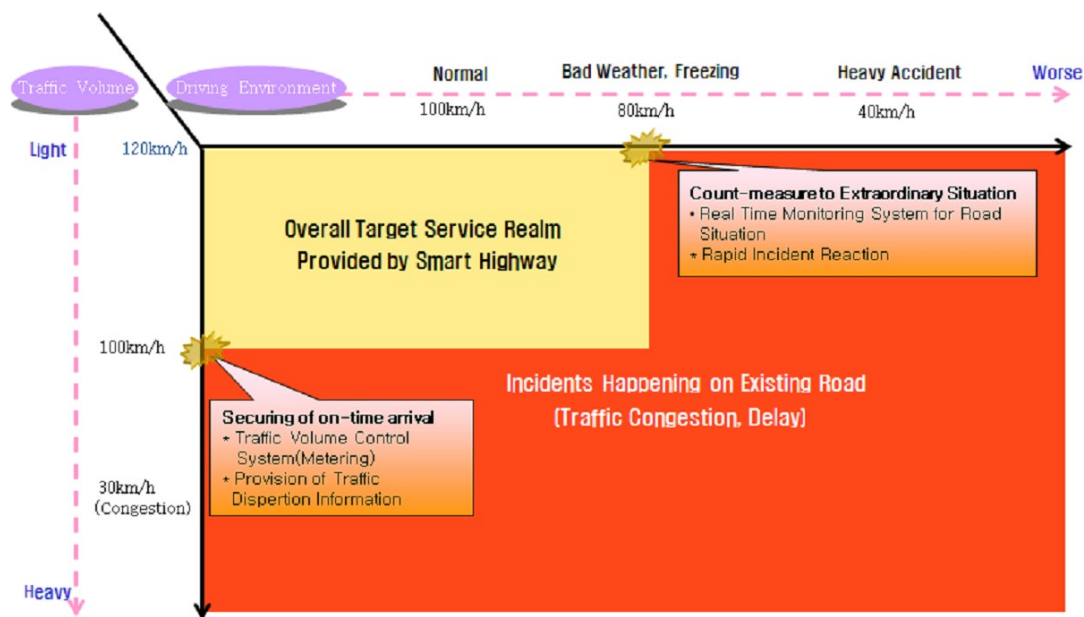


Figure 3. Concept diagram for smart traffic management strategy

The functional differences between SITMS proposed in this study and FTMS (Freeway Traffic Management System), the current expressway management system, are discussed in detail as follows.

Firstly, a navigation system is introduced for direct information exchange among the drivers in terms of information generation or supply system.

Secondly, a direct legacy system of existing expressway or national highway is actualized for complimentary mutual traffic management strategy.

Thirdly, a monitoring function to find out the road situation on real-time basis is strengthened a lot.

Fourthly, a management control strategy to maintain the smooth flow of the entire road system continuously is actualized. Finally, such countermeasures customized for the frequent causes of traffic incidents (i.e. traffic congestion and traffic accident) as maintenance/repair, traffic accident, bad weather, etc. is implemented.

This road operation system is possible when the information environment of ubiquitous concept is applied to the road. When this control strategy is applied, over 50% reduction in traffic accidents in comparison to the situation before the application and on-time arrival of vehicles will be ensured to create a new chapter for road service.

#### 4.2. MULTI-COUNTERMEASURES

SITMS is to be equipped with real-time countermeasure system in multi-dimension at the time of a traffic incident through its link with advanced vehicle control system.

Let us suppose a traffic accident on the road. SITMS can be ready for a comprehensive countermeasure largely in five ways.

Firstly, the driver in the accident vehicle can call the emergency manager with his OBU, and the manager can react to the emergency.

Secondly, even if the driver in the accident vehicle does not call the emergency manager, the smart vehicle will recognize the collision impact or the inflation of air bag to let the manager know of the emergency so that the manager can react.

Thirdly, other drivers, who have witnessed the sudden incident, can provide such information to the road manager with his OBU, bringing about the manager's emergency countermeasure.

Fourthly, the road manager can track the path of the vehicle and can react to the incident of abnormal driving path.

Lastly, the vehicle involved in an accident can automatically transmit warning signal to the vehicles around it through V2V-based communication.

Thus, an environment of rapid and appropriate reaction to a sudden traffic incident can be provided through this dynamic network between road and individual vehicle.

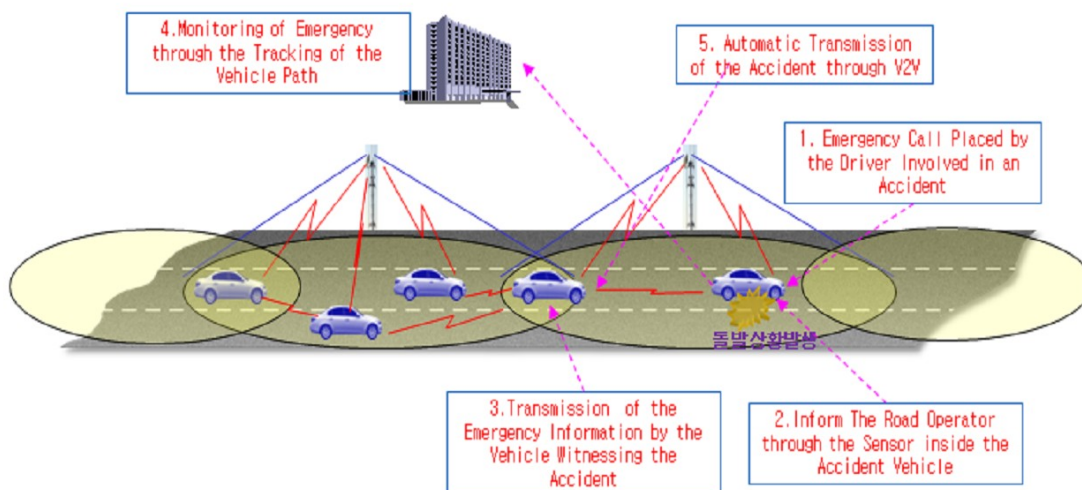


Figure 4. Incident Reaction Multi-Countermeasures

#### 4.3. CONTINUOUS INFORMATION FEED

Smart information environment provides continuous information sharing between individual user and operator (manager). Accordingly, Call & Response (C&R) information service to give and receive mutual information is actualized.

Smart information environment means customized and bi-directional information service to provide continuous information exchange system between the C&R information-served road and smart vehicle. This is a concept never approached by any road information service project around the world.

The services provided through this information environment are listed as follows.

- C&R safety driving service

- This service deviates from the traditional group-based safety information sharing and provides safety information customized for an individual vehicle. In other words, the driver can provide and request information on the safety and traffic situation around him/her continuously. Additionally, the road manager can continuously monitor the driving path of individual vehicle to lead it to safe driving.

- C&R on-time arrival guarantee service

- The information necessary to shorten the driving time for individual driver is customized and provided to the driver. This service is largely divided into traffic route information system during normal traffic situation and during a sudden traffic incident.

- C&R travel convenience service

- This service provides an information service to ask and answer the questions for comfortable travel. This means various guide signs on the road shoulder are displayed on the OBU inside the vehicle.

## V. MAJOR SERVICES OF SITMS

### 5.1. PERFORMANCE PROCEDURES

<Figure 5> illustrates the flow of the process to select important services of SITMS.

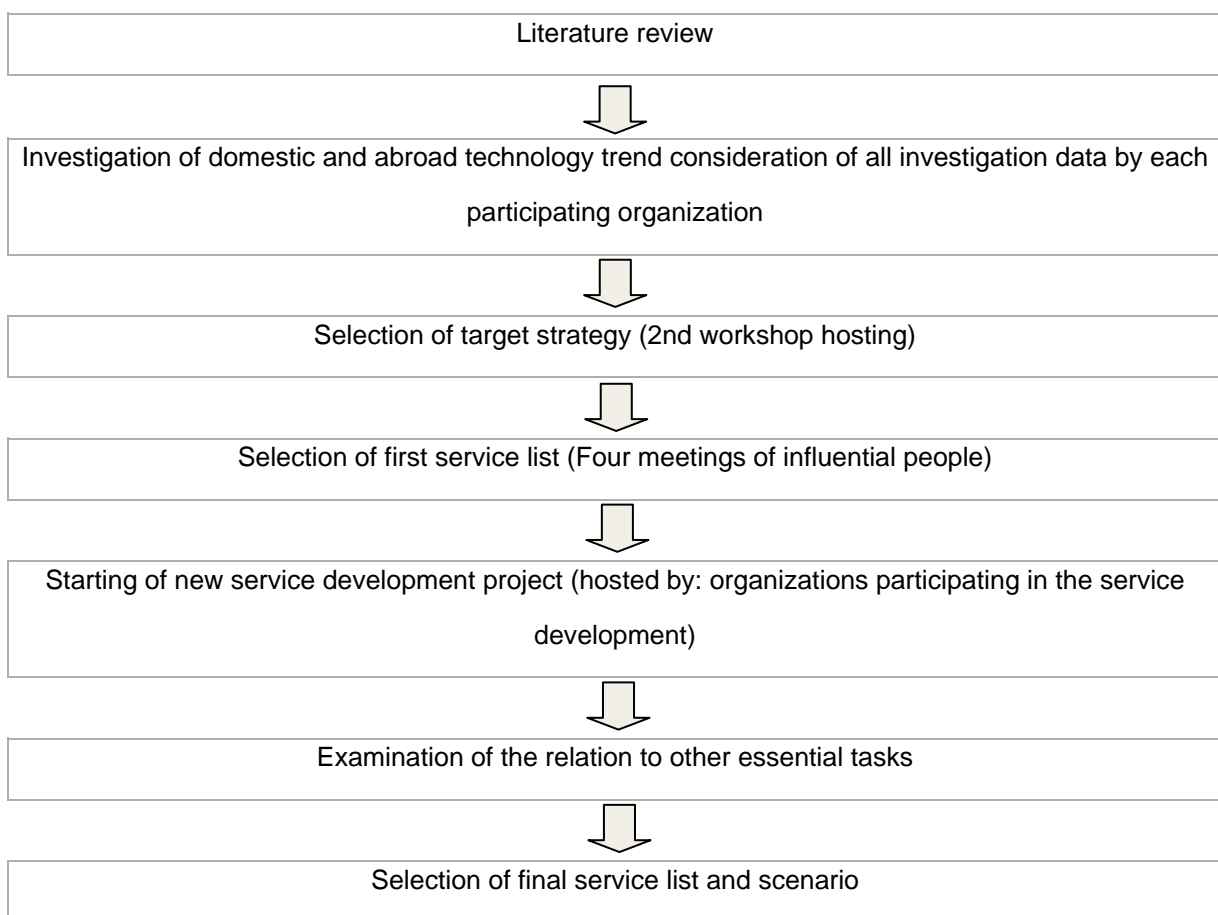


Figure 5. Flowchart of SITMS service selection

### 5.2. LIST OF SITMS SERVICES

SITMS is comprised of 13 large categories and 32 detailed services. The characteristics of each service are discussed as follows.

Table 1. List of SITMS services



Classification large category	service	unit service system
Traffic operation management	<input type="checkbox"/> traffic flow control	<input type="checkbox"/> entrance/exit ramp control system <input type="checkbox"/> variable speed control system
	<input type="checkbox"/> hazardous road zone management	<input type="checkbox"/> fog management system <input type="checkbox"/> heavy snowfall management system
Emergency situation management	<input type="checkbox"/> sudden incident management	<input type="checkbox"/> sudden incident recognition system <input type="checkbox"/> sudden incident reaction countermeasure
		<input type="checkbox"/> advanced vehicle to remove road obstacles
Information collection	<input type="checkbox"/> traffic information collection	<input type="checkbox"/> OBU-based information collection system <input type="checkbox"/> road condition information collection <input type="checkbox"/> road surveillance-based information collection system
		<input type="checkbox"/> advanced vehicle for road information collection
		<input type="checkbox"/> air pollution information collection system <input type="checkbox"/> noise information collection system
	<input type="checkbox"/> environment information collection	
Electronic payment of toll charge	<input type="checkbox"/> multi-lane toll payment	<input type="checkbox"/> multi-lane toll payment and communication system <input type="checkbox"/> multi-lane toll payment operation and management system
Traffic information analysis management	<input type="checkbox"/> prediction of traffic information	<input type="checkbox"/> traffic simulation program <input type="checkbox"/> automatic situation assessment
Provision of comprehensive traffic information	<input type="checkbox"/> provision of comprehensive traffic information	<input type="checkbox"/> provision of comprehensive traffic information
	<input type="checkbox"/> travel route guidance	<input type="checkbox"/> dynamic travel route guidance
Provision of traffic information	<input type="checkbox"/> provision of traffic information during driving	<input type="checkbox"/> provision of OBU information <input type="checkbox"/> provision of VMS information
	<input type="checkbox"/> provision of added-value information	<input type="checkbox"/> travel convenience information <input type="checkbox"/> internet support (free of charge)
Road facility management	<input type="checkbox"/> road facility maintenance/management	<input type="checkbox"/> comprehensive road facility maintenance/management <input type="checkbox"/> maintenance and management of remote operation system
Support for safe driving	<input type="checkbox"/> support for safe driving	<input type="checkbox"/> system for preventing breakaway from the driving path <input type="checkbox"/> driver's calling countermeasure <input type="checkbox"/> V2V-based emergency warning <input type="checkbox"/> provision of sudden obstacle information <input type="checkbox"/> provision of safe driving speed depending on the road situation

☐ Safety support service

## Special Session

- provides advanced safe driving environment through real-time relay of mutual information exchange between the road and individual vehicle (expected effect : 50% reduction in the accident compared to current expressway accident statistics)

- Representative Service: safety driving guide, safety support service customized for smart vehicle

### ☐ Mobility improvement service

- Establishment of road traffic environment, which can maintain cruise-free speed (over 100km/h) from the time of entrance to the time of exit (in case of accident, countermeasure reaction within 6 minutes)

- Representative Service: traffic flow management from entrance to exit, traffic flow management of the main traffic lane, sudden incident management, multi-lane based toll payment

### ☐ Convenience support service

- Establishment of information service system customized for the maximization of the convenience of the acquisition of traffic information by the driver (provision of free-of-charge and accurate convenience information at real-time basis)

- Representative Service: provision of travel convenience information, free-of-charge web environment

### ☐ Operation support service

- Establishment of advanced traffic operation system for strengthening the support for the road operators and active countermeasure system in response to the road situation

- Representative Service: advanced vehicle, information supply and management system, multiple information collection system, automated road system, support system for environment management

## VI. CONCLUSIONS AND RECOMMENDATIONS

The realization target and the direction for building SITMS, a smart highway operation system, as well as its provided services have been discussed.

SITMS aims at building the information highway centered on the users unlike the past practice of centering on the road operator. Especially, the direction for its establishment is set on the provision of customized and continuous road service through the linkage between the operator and the user on the entity basis.

After all, the success of SITMS depends on a certain degree of connectivity among the entities composing the road of the future. In other words, the key for the future road operation system is the capacity to connect the road and vehicle directly and around the incidents and what level of this capacity can be attained.

Smart information environment asks for mutual information exchange among the entities of the road and makes it happen. Its purpose is to realize the information environment so that the information exchange in both ways can be provided. It is not yet decided with which communication media to make this happen. However, the communication method will be decided comprehensively by considering the economy, compatibility, expansion capacity, etc.

Nonetheless, since future information technology businesses are geared to the direction with the same major premise of comprehensive consideration of the needs of the manager and the user, it is believed that an amicable agreement can be reached among them.

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